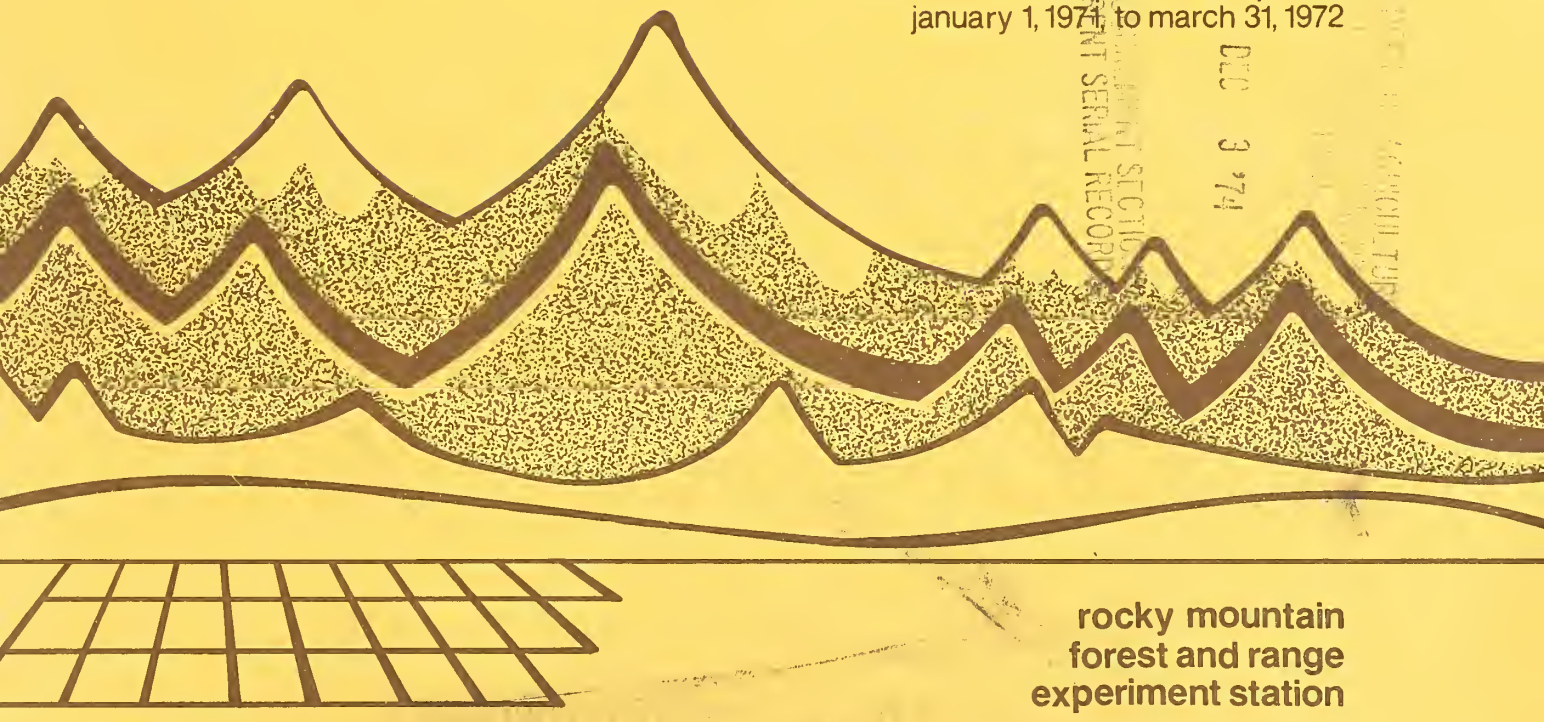
forestry research highlights 1971

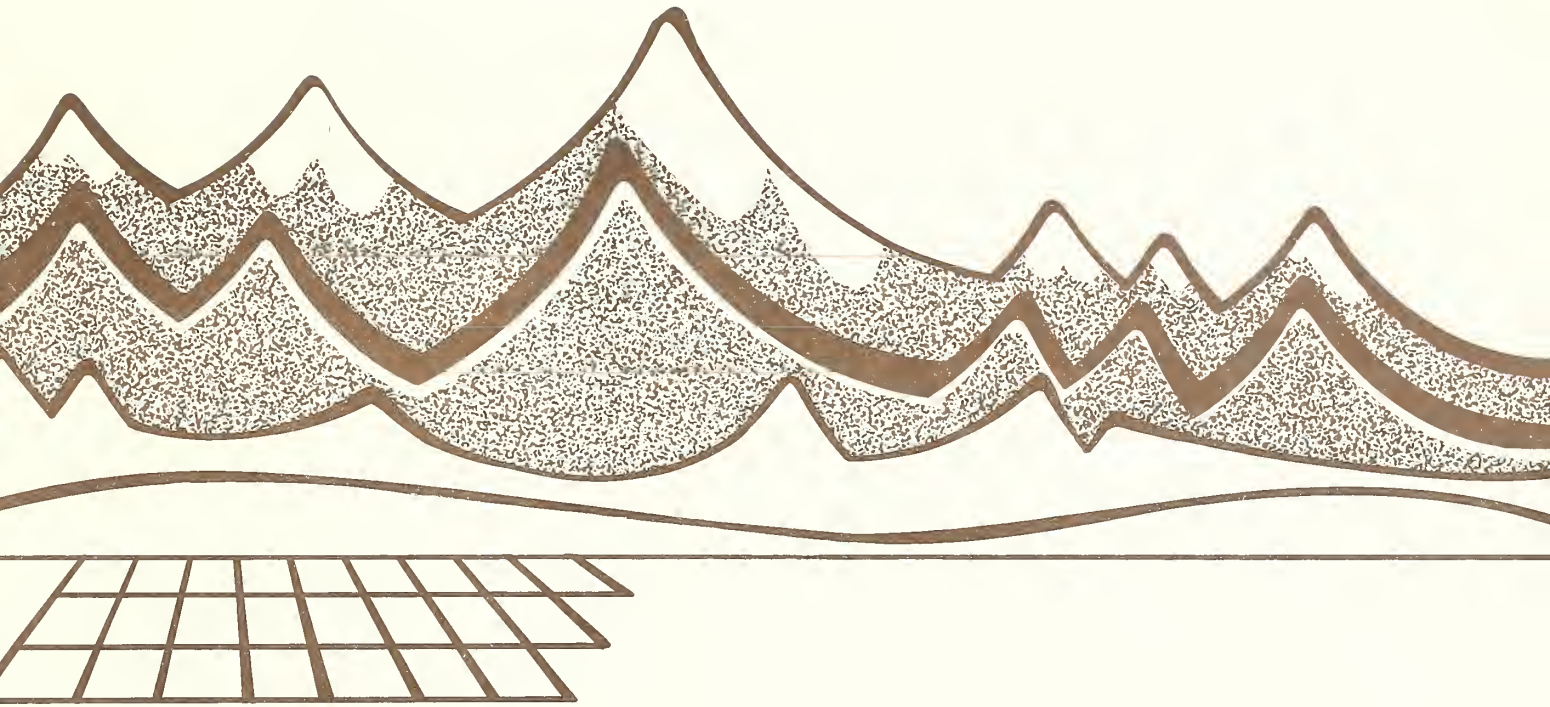
a report for the period
january 1, 1971, to march 31, 1972



rocky mountain
forest and range
experiment station

forest service
u. s. department of agriculture

seeking better ways to manage natural resources on forest and range lands in the great plains, central rockies and southwest



from the director

During recent years the management of natural resources has become a direct concern of millions of Americans. Our growing population seeks more and more of the necessities and comforts of life produced by natural resources. This trend is particularly true of the rapidly developing Central Rocky Mountains and the Southwest. Coupled with this demand for physical products is an increasing desire to preserve the natural features of the environment — features that make the world a pleasant, healthy place to live — features that have a right to exist as part of creation.

So, demands for physical goods and unaltered environment must be reconciled. Concerns over clearcutting, vegetation and insect control with chemicals, wilderness preservation, mountain subdivision development, strip mining, water use and quality, and endangered wildlife species bear witness to the need for more information. Answers must be found that satisfy man's wants and desires on both fronts.

The pages of this report contain several of the past year's research developments I believe you will find of interest. I have changed our report format this year so you will not find a review of every project, as has been done in the past. Rather, I have chosen to tell you about major events and research results to illustrate the thrust of our work. In addition, a complete annotated list of all research results published during the year is included. I hope this list will help you if you desire more information on a given subject.

We at the Rocky Mountain Station have a long history of research into the workings of nature. Our emphasis now is to couple this knowledge with human needs and desires to insure quality of life in the future. I welcome your comments, ideas, and suggestions on our endeavors to achieve this goal.

KARL F. WENGER
Director

special events

director raymond price retires

Raymond Price, Rocky Mountain Station Director for 18 years, retired in 1971. His Forest Service career spanned nearly 41 years. Dr. Karl F. Wenger was named to take over Station leadership. Dr. Wenger came to the Station from national headquarters in Washington, D. C. where he served for 5 years as Chief of Timber Culture and Ecology Research in the Forest Service. His earlier assignments centered around silviculture research in the pine forests of the southeastern United States. Dr. Wenger holds a Ph.D. degree in forestry from Duke University.

Mr. Price became Director in 1953 when the Southwestern and Rocky Mountain Stations were combined, a reorganization effort for which he was largely responsible. Prior to 1953, he had guided research activities at the Southwestern Station (Tucson, Arizona) for 11 years. Earlier career activities led Mr. Price to various range management research jobs in Washington, D.C. and Utah. He was recognized as an authority in range-related research, and published 16 scientific bulletins and papers in addition to his administrative responsibilities. He served 3 years as a technical advisor to the Secretary of Agriculture's Appeals Board, and in 1970, as an official delegate to the 11th International Grassland Congress held in Queensland, Australia.

While Director of the Southwestern and Rocky Mountain Stations, Mr. Price was instrumental in organizing comprehensive watershed research projects in New Mexico and Arizona. The Arizona Beaver Creek Multiple Use Evaluation Project is a direct result of his leadership. It was the first program of its kind created to provide multiple use and economic evaluations of practices designed to increase streamflow in the Southwest.

Mr. Price developed strong cooperative research programs with colleges and universities in the Station territory. Field laboratories were located on campuses, which greatly facilitates information exchange among scientists. Five new laboratory buildings were constructed, including the Station headquarters at Colorado State University. Through Mr. Price's efforts, the laboratory at Fort Collins became the national center for research into avalanche causes and methods for predicting and controlling avalanches. Many other research efforts initiated under Raymond Price's leadership will produce information essential to wise land management for years to come.

Raymond Price

Dr. Karl F. Wenger

construction underway on lincoln laboratory

Construction has begun on the long-needed Great Plains tree research laboratory at Lincoln, Nebraska. It is being built on land made available by the University of Nebraska on its east campus. The university has provided office and laboratory space for three Station scientists and

their supporting personnel since the Great Plains unit was established in 1953. The new facility should be completed in the summer of 1973.

The office and laboratory building will provide working area for an anticipated staff of 10 scientists plus technical and clerical help. Nearby, a headhouse-greenhouse will supplement the laboratories for experiments to clarify requirements for raising trees in the severe Plains environment.

The Lincoln unit is responsible for developing better ways to grow and use trees in the Great Plains, as well as finding effective methods for protecting these trees from disease. Research falls into four major categories: (1) Development of genetically superior trees capable of rapid growth and long life in the Plains environment; (2) upgrading tree nursery management techniques to increase seedling production; (3) understanding the biology of diseases that infect Great Plains trees, and developing environmentally safe methods for controlling these diseases in nurseries and field plantings; and (4) seeking better systems of caring for and managing established tree plantations in the Plains.

forest service and universities unite in man-environment research

The Rocky Mountain Forest and Range Experiment Station has joined forces with nine major western universities to tackle the investigation of problems relating to man and his open-space environment. The group is organized as the "Eisenhower Consortium for Western Environmental Forestry Research."

By combining specialized research talents available in the universities and the Rocky Mountain Station, the consortium members hope to acquire much needed insight into environmental problems associated with rapid population growth in the Central and Southern Rockies and adjacent High Plains. The overall question facing consortium researchers is: How can the needs and wants of the rising permanent and transient populations be satisfied while maintaining, or even enhancing, the features of the natural environment which attracted the people in the first place?

Much of the research will deal with ecologic, social, and economic impacts created by permanent and transient recreation activities on wild lands; and how to provide for the welfare of people and open-space environment at the same time. Examples of research efforts now underway at several universities include studies to determine: the effect of second homes and related vacation developments on the quality of streams and groundwater; the ecological effects of snowmobiling; the environmental, economic, and social effects of the urbanization of mountain watersheds; factors affecting vegetation on ski slopes; and opportunities for improving waste management on outdoor recreation areas. Funds for these studies are provided through cooperative agreements between the respective universities and the Forest Service.

Universities participating in the consortium are Northern Arizona University, University of Arizona, Arizona State University, Colorado State University, University of Colorado, New

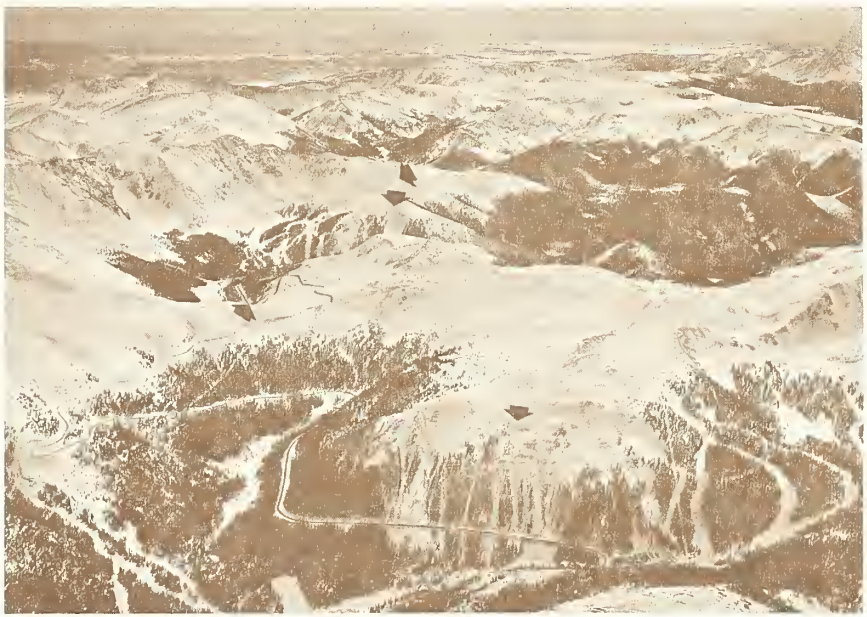
Mexico State University, University of New Mexico, Texas Tech University, and University of Wyoming.

avalanche and blowing snow research moves ahead

Avalanche hazard research at the Station is being intensified to meet growing safety needs. The boom in winter recreation activities in mountainous areas has increased the likelihood of avalanche accidents. The rapid growth of downhill and cross-country skiing, snowmobiling, and winter recreation homes means more people are in the mountains or along the transmountain highways during avalanche season. These recreationists, together with other highway users, miners, and those concerned with transmountain powerlines and mountaintop communication facilities, would all benefit greatly if avalanche hazard could be evaluated more reliably.

Substantial progress has been made toward developing an avalanche alert system based on current weather information and past records of avalanche activity under similar conditions. The hazard prediction model being developed is based on data from the Colorado Rocky Mountains. However, it should be easy to expand application to other mountain areas by using information collected from the fast-growing Forest Service "Avalanche and Mountain Weather Reporting Network."

The role of drifting snow in building up avalanche hazard is also receiving increased atten-



An aerial view of a section of U.S. Highway 6 in the Colorado Rockies reveals potential avalanche source areas. Arrows indicate snow buildup zones at the heads of avalanche paths. Note the position of several zones with respect to the highways and winter recreation areas.

Credit-Roach Photomurals, Denver

tion. Station scientists have learned that the distance snow particles can be blown before they vaporize is highly dependent on particle size, air temperature, solar radiation, and humidity. Using this information, scientists can determine the upwind area that contributes drifting snow to cornices and other avalanche starting zones. It now appears feasible to control this snow buildup in some areas, thus reducing avalanche danger.

Blowing snow research has potential for applications in addition to avalanche control. Basic information can be applied to regulate snow accumulation on selected areas of deer winter range, increase accumulation on desired watershed areas, and minimize blowing snow on highways.

beaver creek resource management research intensified

Resource management research by scientists in the ponderosa pine belt of Arizona will be more highly coordinated in the future as a result of a thorough review by a team of specialists appointed by the Chief of the Forest Service. The 275,000-acre Beaver Creek watershed was selected in 1956 for research to develop management techniques to increase water production. In 1960, the scope of the research was broadened to include the effects of water yield improvement measures on all other resources. Now it will encompass the entire array of multiple use management problems in the ponderosa pine zone of the Southwest.

The review was prompted by the need for an expanded research effort to deal adequately with: (1) the numerous and complex interrelationships that must be taken into account in managing the southwestern ponderosa pine zone for the array of goods and services demanded by the public; and (2) the need to protect and maintain the characteristics of the ponderosa pine ecosystem. The new research will deal with the biological, esthetic, social, and economic consequences of resource management measures that emphasize water production.

A pilot trial of land management systems is being devised, based on data already obtained from small experimental watersheds. The 11,000-acre Woods Canyon drainage has been selected as the experimentation area for management systems that will incorporate the most up-to-date techniques and knowledge of resource inventories, cultural treatments, and environmental monitoring. Resource response and economic data will be incorporated into systems that will enable the land manager to evaluate feasible management alternatives. The pilot trial will be conducted jointly by management and research people, thus providing the training and experience needed to use the same management approach on other areas.

research highlights

for references cited see list of publications at end

national fire-danger rating system ready for operational use

In the past, land management agencies, including the Forest Service, have used a variety of systems for predicting fire danger. Over the years it became apparent that a uniform danger rating method was needed for the entire Nation if mutual-assistance agreements and communications among people concerned with wild land fires were to work effectively.

The National Fire-Danger Rating Research Work Unit at Fort Collins has completed initial development of a national system. Research begun in 1968 has now seen 2 years of testing and refinement. During 1970 and 1971, field trials were conducted at nearly 150 stations from Maine to California. National Forests, Department of Interior agencies, and State agencies all participated in the trials. The rating system became fully operational and available for use in 1972 (Deeming et al. 1972).

The new system provides a common, scientifically sound tool for all agencies. It is designed to help land managers use weather, fuel, and other conditions to predict the potential occurrence, behavior, and suppression difficulty of forest fires. It also provides a common basis for evaluating the effects of various forest management programs and stand treatments on fire danger. The system has been officially adopted and scheduled for use throughout the Forest Service by 1973.

The National Fire-Danger Rating System is a unified program designed to help all land managers predict critical fire hazard periods (A), and to plan effective control measures should fires occur during these critical times (B).

Credit photo A — R. A. Baker, USFS
Credit photo B — Rocky Mountain Region, USFS

greenhouse speeds seedling production

Trees planted in the Rocky Mountains and the Great Plains are normally grown in forest nurseries. It takes 2 to 5 years to grow suitable planting stock this way. Thus the demand for seedlings must be predicted several years ahead, and the seedlings in the nurseries are subject to damage and loss by adverse weather, diseases, and insects. Losses after planting in the forest may be severe also, often as a result of root damage in lifting, transporting, and replanting the nursery trees.

Research at the Station has developed a system to overcome these problems. Seedlings are grown in plastic plug molds in a controlled-environment greenhouse. Precise manipulation of light, temperature, moisture, nutrients, and carbon dioxide in the greenhouse environment stimulates rapid seedling growth (Tinus 1971, 1972).

An analysis comparing plug mold seedlings produced in a greenhouse with bare root seedlings in a nursery indicates that the plug mold trees

Plant Physiologist Richard W. Tinus examines 6-month-old Siberian larch seedlings grown in plug molds in a controlled-environment greenhouse (A). Soil remains packed around the roots of plug mold seedlings (B), thus avoiding damage when they are removed from the molds for planting.

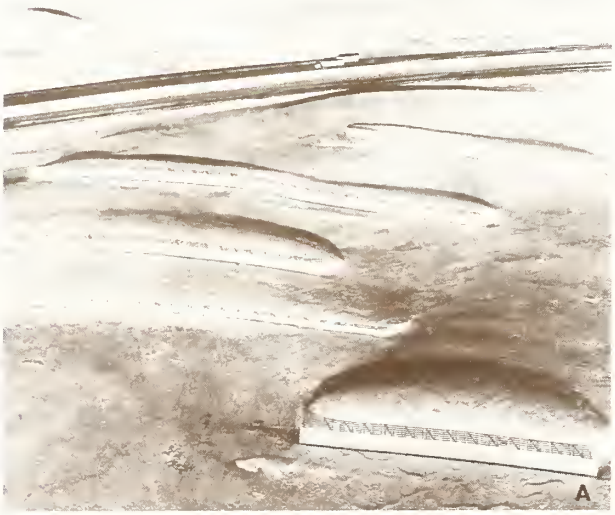
have substantial advantages. Some of these appear to be: production of plantable seedlings in 1 year or less, reduction of losses while growing the planting stock, and improvement in field survival. Greenhouse production also yields other benefits. Because of reduced seedling losses, growers can afford to use the best seed available, and the shorter production period gives managers greater flexibility in planning and timing forest planting.

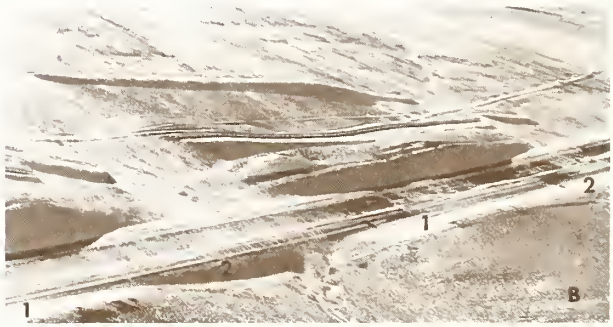
Based on this research, the Kansas Forestry, Fish, and Game Commission is constructing a controlled-environment greenhouse in Manhattan, Kansas. The Colorado State Forest Service is planning a semicontrolled-environment unit in Fort Collins, and the U.S. Forest Service has plans for a unit at its Mount Sopris Nursery in central Colorado.

safety for winter travelers improved on wyoming highways

Several major highways in Wyoming are plagued by ground blizzards following winter snowstorms. Visibility is reduced to nearly nothing, and road surfaces become extremely icy or are drifted closed. During the winter of 1970-71, the section of Interstate 80 between Laramie and Rock Springs was closed for 208 hours.

Because of their previous research on controlling snowdrifts to increase water supplies, Station scientists were asked by the Wyoming Highway Department to help design a fence system to control drifting snow on critical sections of I-80 the next winter. Based on research in the manipulation of blowing snow, fence sizes and locations for 29 sites were carefully planned to trap and hold enough snow to keep the highway





Carefully designed snow fences on Interstate 80 in Wyoming retain snow that would have drifted into the highway cut at the top of the photo (A). Areas marked 1 (B) show that proper snow fence design not only prevents drifts, but also improves highway visibility. Although heavy drifts do not accumulate in areas marked 2, visibility is poor due to uncontrolled blowing snow.

clear during drifting conditions. The summer of 1971 saw 63,000 feet of fence installed.

Results of the 1971-72 winter experiment were dramatic (Wyoming Highway Department 1971, 1972). Roadcuts that drifted full the previous winter remained open, while other uncontrolled problem sections along the highway continued to drift full. Significantly, visibility in the lee of the fences improved greatly, and motorists were spared the ground blizzard "white-outs" and icy road surfaces experienced at other trouble locations. The Highway Department anticipates that money saved in snow removal costs will more than pay for construction of the snow fences within a few years.

As a result of this trial application, the Wyoming Highway Department is planning additional snow fencing along I-80, as well as evaluation of the snow fence needs along other highways in the State.

secrets of dwarf mistletoe identification revealed

Dwarf mistletoes have long been known as serious parasites that sap strength from growing conifers. The severity of damage varies with the species of mistletoe. A 9-year study to identify dwarf mistletoe species was completed in 1971. This work has resulted in publication of "Biology and Classification of the Dwarf Mistletoes" (Hawksworth and Wiens 1972). Recently, the Forest Service won a blue ribbon at the Nationwide American Association of Agricultural College Editors' contest for excellence in editorial work done on the book. It features written descriptions, detailed sketches, color photos, and maps to help identify species. Identification will assist scientists in future efforts to evaluate damage caused by the respective dwarf mistletoes, and to find ways to control this damage.

Over 5,000 dwarf mistletoe specimens from around the world were studied. Among these, 28 species, 5 subspecies, and 2 special forms of one species were recognized. Dwarf mistletoes are found from southern Europe, to central Africa, to China in the Eastern Hemisphere. In the Western Hemisphere, where the most serious damage is caused, they thrive from Alaska and Canada to Honduras and Hispaniola. Most of the dwarf mistletoe species occur in the western United States and Mexico.

Frank G. Hawksworth, Chief Plant Pathologist, examined over 5,000 dwarf mistletoe specimens from around the world to prepare the book "Biology and Classification of the Dwarf Mistletoes." He was assisted by Dr. Delbert Wiens of the University of Utah.

scientists use computers to develop management approach for mistletoe-infested lodge pole pine

How can the forester responsible for lodgepole pine, infested with dwarf mistletoe, plan his management efforts? Previously, yield tables available for his use were applicable only to healthy forests.

A program has been developed at the Station to help managers decide what to do (Myers, Hawksworth, and Stewart 1971). Using computers, they can simulate results of various thinning intensities and frequencies, and alternative yields can be predicted for any given stand. For example: Suppose a manager has lodgepole pine which should produce reasonable wood fiber volumes at 130 years of age (site 70). Assume that the stand was infected by dwarf mistletoe when it was 10 years old (a very common occurrence). According to the new yield tables, if sanitation thinnings are begun at age 30 and conducted each 20 years thereafter, the stand should produce acceptable cubic-foot and sawtimber volumes by 130 years. However, the yields will be one-third less than for trees free of mistletoe on similar sites. On the other hand, if thinning is delayed until the infected trees are 50 years old, it is too late. The mistletoe will have gained such a foothold that no sawtimber volume, and only one-third of the healthy stand cubic-foot volume will be produced when the trees are 130 years old.

Application of this work has been tried in cooperation with the Rocky Mountain Region, U. S. Forest Service. Several experimental cases were set up, and the analyses revealed that many lodgepole pine stands infested with dwarf mistletoe are worth saving and will respond to thinning treatment.

guide to shelterbelt insects aids battle to save trees in northern great plains

Trees and shrubs are planted for a variety of reasons in the northern Great Plains. They protect crops, livestock, and soil from wind; provide wildlife habitat; control drifting snow; and provide beauty and privacy. Since most of these trees and shrubs are living outside their native

Associate Entomologist John D. Stein, Jr., collects a specimen of vagabond aphid damage from a cottonwood tree. This is one of many types of insect damage described by Stein in the recently published "Key to Shelterbelt Insects of the Northern Great Plains."

habitat, they are vulnerable to insect injury. Land managers have long needed a tool to help them identify harmful insects so they could take appropriate action to protect valuable shelterbelts and woodlands from destruction.

To help solve this problem, a key to the identity of 226 shelterbelt insects in the northern Great Plains has been developed (Stein and Patrick 1972). The key is designed as an aid in identifying insects for those who have no specialized training in entomology. Photos, sketches, and charts combined with brief paired statements make the book an easy-to-use tool. The key can be used in the Dakotas and parts of Montana, Wyoming, Nebraska, Minnesota, and Iowa.

lehmann lovegrass both credit and debit to southwestern range management

Introduced plants sometimes appear to be the immediate solution to problems created by losses of native plants. Such is the case with Lehmann lovegrass in the Southwest. This native South African grass has been widely used to revegetate semidesert rangelands when native grasses have been destroyed by overgrazing, fire, or other catastrophe.

Experiments with Lehmann lovegrass on the Santa Rita Experimental Range in Arizona show that it is easily established under adverse conditions. It quickly becomes reestablished from seed following fire, and can maintain a relatively dense stand under heavy grazing. It can also produce more herbage than native species when competing with mesquite. Test plantings since 1930 reveal that it does well where rainfall is 13 to 17 inches per year and elevations run 3,500 to 4,500 feet.

On the other hand, Lehmann lovegrass can replace native perennial grasses when planted on

Lehmann lovegrass occupied only a small strip in this experimental test plot in 1946 (A). By 1968 (B), it had taken over the entire area, forcing out native grasses.

sites to which it is well adapted. One experiment begun in 1945 established this lovegrass in a narrow strip inside a plot where native grasses were producing over 300 pounds per acre at the time. By 1968, Lehmann lovegrass was growing throughout the plot and producing 580 pounds per acre, while native grasses had dropped to 32 pounds.

Conclusions reached were that Lehmann lovegrass is excellent for reestablishing cover on denuded range. However, where there are enough native grasses to respond to sound range management and shrub control, the native species can produce more **desirable** forage. In such situations, it may not be wise to risk replacing native perennial grasses with Lehmann lovegrass (Cable 1971).

getting the word out

an annotated list of publications from
january 1, 1971, to march 31, 1972

evaluation of multiple use activities on southwestern watersheds

BAKER, MALCHUS B., JR., HARRY E. BROWN, AND NORMAN E. CHAMPAGNE, JR.

1971.

Hydrologic performance of the Beaver Creek watersheds during a 100-year storm.

Amer. Geophys. Union Trans. 52: 828. (Abstr.)

On Sept. 5, 1970, up to 4.9 inches of rain fell on juniper watersheds, up to 6.7 inches on pine watersheds. Total runoff, peak discharges, and sediment yields are compared from thinned, stripcut, clearcut, and control watersheds.

BOSTER, RON S.

1971.

A critical appraisal of the environmental movement.

J. Forest. 69: 12-16.

The 'environmental crisis' is neither a question of resource shortage, nor population per se. Rather, it is a complex intermingling of institutional and technological systems whose various forms of pollution can only be minimized (not eliminated) within a framework of social, political, economic, and technological constraints.

BOSTER, RONALD S.

1971.

Ground water and the environmental movement.

Ground Water 9(1): 2-4.

Guest editorial suggests time is right to move to protect vulnerable ground-water supplies from pollution.

BROWN, HARRY E.

1971.

Evaluating watershed management alternatives.

Amer. Soc. Civil Eng., J. Irrig. and Drain. Div. 97(IR1): 93-108.

Preliminary multiple use evaluations are presented for watershed management treatments designed to increase water yield. Such evaluations, when completed, will make available to land managers proven techniques for increasing streamflow, and in addition will provide estimates of consequent changes in timber, range, and wildlife products.

CLARY, WARREN P.

1971.

Effects of Utah juniper removal on herbage yields from Springerville soils.

J. Range Manage. 24: 373-378.

Yields of understory vegetation with an undisturbed juniper overstory averaged 223 pounds per acre including 50 pounds of perennial grasses. Yields with the overstory removed averaged 981 pounds per acre including 193 pounds of perennial grasses. Many cleared areas remained in an annual forb—half-shrub stage for a number of years.

CLARY, WARREN P., AND FREDERIC R. LARSON.

1971.

Elk and deer use are related to food sources in Arizona pondersosa pine.

USDA Forest Serv. Res. Note RM-202, 4 p.

Elk use within ponderosa pine stands was higher on those areas with higher herbage yields, lower timber basal areas, and some alligator juniper. Long-term deer use appeared to be essentially random.

FFOLLIOTT, PETER F.,* AND ROLAND L. BARGER.

1971.

New approach to estimating timber products.

Progr. Agr. Ariz. 23(3): 11-13.

Inventory data for sample trees are used in combination with standard procedures for estimating volume, scaling, and grading to evaluate primary product potential. Based on USDA Forest Serv. Res. Pap. RM-57.

FFOLLIOTT, PETER F., FREDERIC R. LARSON, AND ROLAND L. BARGER.

1971.

Predicting scaled volume recoverable from cutover southwestern ponderosa pine stands.

USDA Forest Serv. Res. Note RM-195, 8 p.

Standard volume tables provide a means of estimating average gross volume per tree in standing timber. The gross volume actually recoverable from the timber may vary from estimated volume because of (1) differences between assumed volume table utilization standards and actual logging practices, (2) differences in form of timber, and (3) differences between stick-scaled and equation-calculated volumes. The tables presented provide a means of predicting scaled volume recoverable from cutover southwestern ponderosa pine stands on sites of low and intermediate quality.

*Private, state, or federal cooperator.

GIESKE, MICHAEL, AND RONALD S. BOSTER.
1971.
DAMID: a discounting analysis model for investment decisions.
USDA Forest Serv. Res. Note RM-200, 12 p.
Outputs of the computer program include discounted (present) values of individual costs or benefits, a summed net present value for an entire project (set of flows), and project benefit-cost ratios for up to 10 interest rates.

LARSON, FREDERIC R., KARL E. MOESSNER,* AND PETER F. FFOLLIOTT.*
1971.
A comparison of aerial photo and ground measurements of ponderosa pine stands.
USDA Forest Serv. Res. Note RM-192, 4 p.
Inventories of timber volume and density, slope percent, and aspect can be derived by measurements of small scale (1:15,840) aerial photographs backed up by on-the-ground field sampling. For small areas, a larger photo scale (1:6,000) may be more desirable. No advantage was gained with 1:3,000 photos.

MILLER, ROBERT L.
1971.
Clearing an alligator juniper watershed with saws and chemicals: a cost analysis.
USDA Forest Serv. Res. Note RM-183, 8 p.
Manpower, equipment, materials, and vehicle input data were analyzed for seven component jobs involved in an experimental watershed conversion. Analysis indicates that costs may be reduced substantially in an operational program through improved organization, changing prescriptions and techniques, and further cost studies.

forest diseases

ANDREWS, STUART R.
1971.
Red rot of ponderosa pine.
U.S. Dep. Agr. Forest Pest Leafl. 123, 8 p.
Red rot caused by *Polyporus anceps* is the most important heart rot of ponderosa pine in the Southwest, the Black Hills, and parts of Colorado, Montana, and Idaho. Losses are slight elsewhere.

BARANYAY, J. A.,* F. G. HAWKSWORTH, AND R. B. SMITH.*
1971.
Glossary of dwarf mistletoe terms.
Dep. Environ., Pac. Forest Res. Cent., Can. Forest. Serv., Victoria, B.C.
A glossary of 260 terms (including synonyms) used in dwarf mistletoe research and control. Includes a table listing the scientific names, common names, principal hosts, and distribution of the dwarf mistletoes of North America. (Available from the Pacific Forest Research Centre, 506 West Burnside Road, Victoria, B.C., Canada)

BROOKHOUSER, L. W.,* AND GLENN W. PETERSON.
1971.
Infection of Austrian, Scots, and ponderosa pines by *Diplodia pinea*.
Phytopathology 61: 409-414.
In eastern Nebraska, young shoots of all three species were highly susceptible to infection from late April until mid-June; previous years' needles were not susceptible. The pathogen penetrated needles through stomata.

CZABATOR, F. J.,* J. M. STALEY, AND G. A. SNOW.*
1971.
Extensive southern pine needle blight during 1970-1971, and associated fungi.
Plant Dis. Rep. 55: 764-766.
A blight on slash and loblolly pines over extensive areas of six southern States is presumed to have been caused by *Lophodermella cerina*, *Ploioderma lethale*, and infrequently *P. hedgcockii* .

HAWKSWORTH, FRANK G., AND DELBERT WIENS.*
1972.
Biology and classification of the dwarf mistletoes (*Arceuthobium*).
U. S. Dep. Agric., Agric. Handb. 401, 234 p.
Describes 32 recognized taxa: 28 species, 5 subspecies, and 2 *formae speciales*. Classification system is based on extensive field studies of New World species, examination of specimens in major herbaria of North America and Europe, and computer analyses of all taxonomic data.

HINDS, THOMAS E.
1971.
Decay of ponderosa pine sawtimber in the Black Hills.
USDA Forest Serv. Res. Pap. RM-65, 11 p.
Study of logs from 498 trees determined relationships between tree age, volume, and defect. Red rot was

*Private, state, or federal cooperator

responsible for 8.6 percent, brown rots 7.3 percent, and other defects 3.3 percent of the total 19.2 percent defect. Red rot was found in 68 percent of all trees.

HINDS, T. E.

1972.

***Ceratocystis* canker of aspen.**

Phytopathology 62: 213-220.

Several species of *Ceratocystis* are associated with a trunk canker on quaking aspen. *C. fimbriata* is a causal agent. The primary point of canker initiation is at fresh bark wounds.

HINDS, T. E.

1972.

Insect transmission of *Ceratocystis* species associated with aspen cankers.

Phytopathology 62: 221-225.

Nitidulids are considered the principal vectors of *Ceratocystis* canker of aspen in Colorado. Two rove beetles and a root-eating beetle were also vectors of *C. fimbriata* and other *Ceratocystis* species.

HINDS, THOMAS E., AND PAUL E. BUFFAM.*

1971.

Blue stain in Engelmann spruce trap trees treated with cacodylic acid.

USDA Forest Serv. Res. Note RM-201, 4 p.

Living trees were frilled and treated with cacodylic (dimethylarsenic) acid. After 1 year, stain had penetrated the sapwood of untreated trees, but was negligible in treated trees. The treatment that gave the best lethal effect on bark beetles also resulted in least blue stain.

PETERSON, GLENN W., AND RALPH A. READ.

1971.

Resistance to *Dothistroma pini* within geographic sources of *Pinus nigra*.

Phytopathology 61: 149-150.

Of 21 geographic sources evaluated for resistance to the needle blight fungus in eastern Nebraska, some trees within 16 sources were highly resistant; only one geographic source (Yugoslavia) showed universally high resistance.

PETERSON, ROGER S.

1971.

Wave years of infection by western gall rust on pine.

Plant Dis. Rep. 55: 163-167.

In nearly all stands studied, more than 50 percent of *Peridermium harknessii* infections occurred in 1 or 2 years of a 10-year sample period. Epidemics are often only a few miles in extent, but occasional wave years may also be detected over a whole region such as Idaho and adjacent Montana.

RIFFLE, JERRY W.

1971.

Effect of nematodes on root-inhabiting fungi.

p. 97-113. *In* Mycorrhizae. Proc. First N. Am. Conf., Apr. 1969.U. S. Dep. Agr. Misc. Publ. 1189, 255 p.

Mycophagous nematodes can feed on, suppress the growth, and even kill some soil- and root-inhabiting fungi. Several of these nematode species occur in the rhizosphere of trees in forest stands and nurseries.

WEISS, M. J.,* AND J. W. RIFFLE.

1971.

***Armillaria* root rot in a ponderosa pine plantation in New Mexico.**

Plant Dis. Rep. 55: 823-824.

Armillaria mellea was found in four plantations in central New Mexico, and caused serious mortality in one. Mortality was inversely proportional to tree height. This pathogen may be a significant factor in the early survival of ponderosa pine plantations in central New Mexico.

forest fire

DEEMING, JOHN E., AND JAMES W. LANCASTER.

1971.

Background, philosophy, implementation - National Fire Danger Rating System.

USDA Forest Serv., Fire Control Notes 32(2): 4-8.

The National Fire Danger Rating System features three indexes for planning, and three components which rate the basic aspects of fire behavior: ignition, rate of spread, and energy release (intensity). Development of the NFDR System could proceed only after careful consideration of the problem and the establishment of guidelines. These guidelines are now termed the philosophy of National Fire Danger Rating.

**Private, state, or federal cooperator*

DEEMING, JOHN E., JAMES W. LANCASTER, MICHAEL A. FOSBERG, R. WILLIAM FURMAN, AND MARK J. SCHROEDER.*

1972.

National fire-danger rating system.

USDA Forest Serv. Res. Pap. RM-84, 165 p.

The NFDR System produces three indexes — occurrence, burning, and fire load — that measure relative fire potentials. These indexes are derived from the fire behavior components — spread, energy release, and ignition — plus a consideration of risk. Contains instructions and tables to manually compute the indexes and components for nine broad fuel models.

FOSBERG, MICHAEL A.

1971.

Climatological influences on moisture characteristics of dead fuel: theoretical analysis.

Forest Sci. 17: 64-72.

Numerical simulation of dead fuel behavior under different climatological regimes has demonstrated three universal response characteristics of fuels. Response to moisture stress, evaluated both for a complete fuel and for its outer shells, provides a basis for fuels classification. Time required for a fuel to become independent of its previous moisture history provides a basis of evaluating fuel contribution to fire persistence.

FOSBERG, MICHAEL A.

1971.

Moisture content calculations for the 100-hour timelag fuel in fire danger rating.

USDA Forest Serv. Res. Note RM-199, 7 p.

The moisture content is computed from the daily moisture exchange factor and precipitation duration. The computational method is presented in tabular form for quick and easy field use.

FOSBERG, MICHAEL A., AND JOHN E. DEEMING.

1971.

Derivation of the 1- and 10-hour timelag fuel moisture calculations for fire-danger rating.

USDA Forest Serv. Res. Note RM-207, 8 p.

Procedures for calculating the moisture contents of 1- and 10-hour timelag fuels have been developed, based on theoretical calculations of the rate of moisture transport in wood.

FOSBERG, MICHAEL A., AND MARK J. SCHROEDER.*

1971.

Fine herbaceous fuels in fire-danger rating.

USDA Forest Serv. Res. Note RM-185, 7 p.

The moisture content of living herbaceous vegetation is accounted for by solving simultaneous sets of equations for rate-of-spread for various proportions of living herbaceous vegetation.

forest insects

JENNINGS, DANIEL T.

1971.

Ocular anomaly of *Misumenops* sp. (Araneae: Thomisidae).

Southwest. Natur. 15: 503.

The right anterior median eye (AME) of an immature spider taken in Bernalillo Co., New Mexico, was about one-ninth the diameter of the left AME. Defective eye development is rare.

JENNINGS, DANIEL T.

1971.

Plant associations of *Misumenops coloradensis* Gertsch (Araneae: Thomisidae) in central New Mexico.

Southwest. Natur. 16: 201-207.

Adult crab spiders were swept from one species of grass, 11 forbs, and one shrub in central New Mexico. Juveniles were swept from eight grasses, including sedges and rushes, 32 forbs, six shrubs, and three trees. Immatures apparently are less plant specific.

JENNINGS, DANIEL T.

1972.

An overwintering aggregation of spiders (Araneae) on cottonwood in New Mexico.

Entomol. News 83: 61-67.

An overwintering aggregation of 21 spiders was found beneath the starting bark of a Fremont cottonwood limb in Bernalillo County.

**Private, state, or federal cooperator*

MASSEY, CALVIN L.

1971.

Arizona five-spined Ips.

U. S. Dep. Agr., Forest Pest Leafl. 116. 5 p. (Rev.)

Ips lecontei Swaine is the most destructive bark beetle in central and southern Arizona. How to recognize an attack, and methods of natural, applied, and cultural control are discussed.

MASSEY, CALVIN L.

1971.

Nematode associates of several species of *Pissodes* (Coleoptera: Curculionidae) in the United States.

Entomol. Soc. Amer. Ann. 64: 162-169.

Eight new nematode species were collected from galleries of five *Pissodes* weevils: *Mikoletzkya hamdenensis*, *M. pugnea*, *Panagromacra faceta*, *Bealius pissodi*, *Aphelenchoides rhytium*, *Seinura sutura*, *Bursaphelenchus elytrus*, and *Ektaphelenchus lepidus*.

MASSEY, CALVIN L.

1971.

***Omemeea maxbassiensis* n. gen., n. sp. (Nematoda: Aphelenchoididae) from galleries of the bark beetle *Lepersinus californicus* Sw. (Coleoptera: Scolytidae) in North Dakota.**

J. Nematol. 3: 289-291.

Omemeea maxbassiensis n. gen., n. sp. was found inhabiting galleries of a bark beetle, *Lepersinus californicus* Sw., in green ash, *Fraxinus pennsylvanica* Marsh. The genus differs from all other genera in the subfamily in its uniquely shaped umbrella-like head, distinctive stylet, and location of excretory pore.

MASSEY, C. L.

1971.

Two new genera of nematodes parasitic in the eastern subterranean termite, *Reticulitermes flavipes*.

J. Invertebr. Pathol. 17: 238-242.

Termirhabditis fastidiosus n. g., n. sp. was found in the gut, and *Rhabpanus ossiculum* n. g., n. sp. was found in the head. *T. fastidiosus* may be important in its effect on the protozoan complement of the gut of the termite. A new subfamily Cruznematinae is erected; genera placed in the subfamily are *Cruznema*, *Mesorhabditis*, and *Rhabpanus*.

McCAMBRIDGE, W. F.

1971.

Temperature limits of flight of the mountain pine beetle, *Dendroctonus ponderosae*.

Entomol. Soc. Amer. Ann. 64: 534-535.

The mountain pine beetle in central Colorado is capable of flight from about 67 to 107 F under laboratory conditions of 50 percent relative humidity. The warming influence of sunlight on the beetle could be expected to facilitate flight at significantly lower temperatures.

McKNIGHT, M. E.

1971.

Biology and habits of *Bracon politiventris* (Hymenoptera: Braconidae).

Entomol. Soc. Amer. Ann. 64: 620-624.

Bracon politiventris (Cushman) was an abundant parasitoid of the western budworm (*Choristoneura occidentalis* Freeman) in Colorado in 1963. Its apparent importance prompted the laboratory and field studies of its life history and habits reported here.

McKNIGHT, M. E.

1971.

Natural mortality of the western spruce budworm, *Choristoneura occidentalis*, in Colorado.

USDA Forest Serv. Res. Pap. RM-81, 12 p.

Natural mortality was evaluated by analyses of life tables compiled for two generations at three locations. Unidentified factors caused the most significant mortality in populations with decreasing trends.

McKNIGHT, M. E., AND A. D. TAGESTAD.

1972.

***Megachile centuncularis* nest in carpenterworm gallery.**

J. Kans. Entomol. Soc. 45: 51-53.

A nest of a leafcutter bee was found in a larval gallery of the carpenterworm, *Prionoxystus robiniae* (Peck), in green ash. Damage by this or other species of *Megachile* is common on trees in shelterbelts.

*Private, state, or federal cooperator.

SCHMID, J. M.

1971.

Beetles in the spruce forests.

Colo. Outdoors 20(4): 32-35.

Sawdust in bark crevices, buckshot-sized masses of resin, yellowing foliage -these are signs of the spruce beetle. Occasional outbreaks kill thousands of trees. The beetle's habits, life cycle, and possible controls are discussed.

SCHMID, J. M.

1971.

***Medetera aldrichii* (Diptera: Dolichopodidae) in the Black Hills. II. Biology and densities of the immature stages.**

Can. Entomol. 103: 848-853.

Medetera aldrichii Wheeler larvae enter galleries of *Dendroctonus ponderosae* through beetle entrance holes. The fly larvae, which probably cause a major share of the beetle mortality between August and the following May, pupate near beetle-created openings from the galleries to the exterior.

SCHMID, J. M.

1972.

Emergence, attack densities, and seasonal trends of mountain pine beetle (*Dendroctonus ponderosae*) in the Black Hills.

USDA Forest Serv. Res. Note RM-211, 7 p.

Beetles began emerging around July 1 and emerged in peak numbers on August 15, 1966 and 1967. Adults emerged almost simultaneously from north and south sides of trees. Relationships between beetle emergence, evaluation techniques, and control operations are discussed.

SCHMID, J. M., AND ROY C. BECKWITH.*

1972.

The spruce beetle.

U. S. Dep. Agric. For. Pest Leafl. 127, 7 p.

The spruce beetle annually kills 300-500 million board feet of spruce. Overmature trees are usually attacked first, but all diameter classes may be killed. Most outbreaks originate in blowdowns, but cull logs may also be a contributing factor.

STEIN, JOHN D., AND PATRICK C. KENNEDY.*

1972.

Key to shelterbelt insects in the Northern Great Plains.

USDA Forest Serv. Res. Pap. RM-85, 153 p.

An insect key designed to help identify 227 insect species. The text contains 136 figures and 8 color plates to aid in identification. Several tables assist in coordinating host damage with a particular insect species.

STELZER, MILTON J.

1971.

Western tent caterpillar.

U. S. Dep. Agr. Forest Pest Leafl. 119, 5 p.

At high elevations, aspen is the favored host of the tent caterpillar. Cottonwoods, willows, and several shrubs valuable for wildlife browse are also infested at lower elevations. A virus disease that decimates natural caterpillar populations can be introduced into disease-free areas to give effective control.

STEVENS, ROBERT E.

1971.

Fir engraver.

U. S. Dep. Agr., Forest Pest Leafl. 13, 7 p., (Rev.)

This native bark beetle attacks most species of fir in the West, and often causes heavy mortality. No satisfactory applied controls have been developed for large areas. Natural enemies may help control the engraver, but are not effective in preventing outbreaks.

STEVENS, ROBERT E.

1971.

Pine growth retarded following defoliation by the pine needle sheathminer.

J. Econ. Entomol. 64: 1572-1573.

Zelaria-caused defoliations in 1956 and 1960-61 in east-central California retarded pine growth the year or years following attack. Growth appeared to return to normal quickly.

*Private, state, or federal cooperator.

STEVENS, ROBERT E.

1971.

Pine reproduction weevil.

U. S. Dep. Agric. Forest Pest Leafl. 15, 6 p. (Rev.)

This weevil attacks and kills several species of young pines in California, primarily ponderosa pine in plantations. Weevil damage is best prevented by maintaining suitable growing conditions for trees.

STEVENS, ROBERT E.

1971.

Ponderosa pine tip moth.

U. S. Dep. Agr., Forest Pest Leafl. 103, 5 p. (Rev.)

This tip moth is a pest of young trees in the foothill pine forests in California, Oregon, and Washington. Damage is seldom serious.

forest products utilization

BARGER, ROLAND L., AND PETER F. FFOLLIOTT.

1971.

Effects of extractives on specific gravity of southwestern ponderosa pine.

USDA Forest Serv. Res. Note RM-205, 4 p.

Specific gravity was reduced approximately 12 percent (0.421 to 0.371) by the removal of extractives soluble in alcohol, benzene, and water. Extracted specific gravity, a more reliable index of strength and fiber yield, can be estimated by the equation Ext. Sp. Gr. = 0.593 - 0.092/Unext. Sp. Gr.

BARGER, ROLAND L., AND PETER F. FFOLLIOTT.*

1971.

Prospects for cottonwood utilization in Arizona.

Progr. Agr. Ariz. 23(3): 14-16.

Because the resource is limited, cottonwood utilization should be integrated with other species. The wood pulps well, and, because of its high shock resistance, is particularly suited for pallet and crate manufacture.

BARGER, ROLAND L., AND PETER F. FFOLLIOTT.

1972.

Physical characteristics and utilization of major woodland tree species in Arizona.

USDA Forest Serv. Res. Pap. RM-83, 80 p.

Woodland species in the Southwest, primarily Utah and alligator juniper, pinyon pine, and Gambel oak, represent a vast resource potentially useful for veneer, particleboards, charcoal, pulp, and chemical extractives.

HEIDT, JACK D., DONALD A. JAMESON, ROLAND L. BARGER, AND BERNARD J. ERICKSON.

1971.

Determining timber conversion alternatives through computer analysis.

USDA Forest Serv. Res. Pap. RM-74, 27 p.

Computer program MULTI accepts basic field inventory data, calculates gross board-foot and cubic-foot volume, grades or classifies for a number of specified primary products, adjusts gross volume for visual defect, and calculates standard error. Output tables give adjusted gross volume per acre, by grade and size class, for each product independently.

MARKSTROM, DONALD C., AND ROBERT A. HANN.*

1972.

Seasonal variation in wood permeability and stem moisture content of three Rocky Mountain softwoods.

USDA Forest Serv. Res. Note RM-212, 7 p.

Time of year does not affect wood permeability but does affect water content of Engelmann spruce, lodgepole pine, and Douglas-fir trees, especially the sapwood. The water contents were highest during winter.

MUELLER, LINCOLN A., DONALD C. MARKSTROM, AND ROLAND L. BARGER.

1971.

Moisture content of laminated timbers in use in the Rocky Mountain area.

USDA Forest Serv. Res. Pap. RM-73, 8 p.

Equilibrium moisture contents in laminated timbers exposed under a variety of interior and exterior conditions in 25 structures from South Dakota to Arizona remained between 6.6 and 10.5 percent. Thus a fabrication moisture content of 8 percent should prove satisfactory for the Rocky Mountain region.

*Private, state, or federal cooperator.

SETZER, THEODORE S.*

1971.

Estimates of timber products output and plant residues, Arizona, 1969.

USDA Forest Serv. Res. Note INT-130, 4 p.

Roundwood products output decreased slightly from 1966 to 88,500 MCF. Round pulpwood increased to 7,600 MCF. Slightly over half the 45,000 MCF of plant residues was utilized, mainly for pulpwood and fuel.

SETZER, THEODORE S.*

1971.

Estimates of timber products output and plant residues, Colorado, 1969.

USDA Forest Serv. Res. Note INT-131, 4 p.

Roundwood products decreased slightly from 1966 to 48,300 MCF. The 672 MCF round pulpwood was triple the 1966 estimate. About 28 percent of the 26,000 MCF of plant residues were used, mainly for pulpwood and fuel.

SETZER, THEODORE S.*

1971.

Estimates of timber products output and plant residues, New Mexico, 1969.

USDA Forest Serv. Res. Note INT-134, 4 p.

Roundwood products decreased 7 percent from 1966 to 47,000 MCF. About a fourth of the 26,300 MCF of plant residues was used, mostly for pulpwood.

SETZER, THEODORE S.*

1971.

Estimates of timber products output and plant residues, Wyoming and western South Dakota, 1969.

USDA Forest Serv. Res. Note INT-136, 6 p.

Roundwood products decreased slightly from 1966 estimates to 45,000 MCF. Saw log output was up, however. About 29 percent of the 25,000 MCF of plant residues were utilized, mostly for pulpwood and fuel.

YERKES, VERN P., AND R. O. WOODFIN, JR.*

1972.

Veneer recovery from Black Hills ponderosa pine.

USDA Forest Serv. Res. Pap. RM-82, 23 p.

Veneer recovered from a selected sample of 144 sawtimber trees was sufficient in both volume and grades to allow production of at least $^{3}/_{8}$-inch C-D plywood.

mensuration

MYERS, CLIFFORD A.

1971.

Field and computer procedures for managed-stand yield tables.

USDA Forest Serv. Res. Pap. RM-79, 24 p.

Sets of yield tables that show probable results of various management alternatives can be valuable tools for decisionmaking, especially when they can be computed quickly and at relatively low cost with data from temporary plots.

MYERS, CLIFFORD A., FRANK G. HAWKSWORTH, AND JAMES L. STEWART.*

1971.

Simulating yields of managed, dwarf mistletoe-infested lodgepole pine stands.

USDA Forest Serv. Res. Pap. RM-72, 15 p.

Presents a procedure for computing yield tables for diseased, managed, even-aged stands in Colorado and southern Wyoming. Stand age at time of initial infection may be varied as desired. Other control variables include stand age at initial thinning, stocking goals, and frequency of thinning. Stand conditions and severity of mistletoe infestation change with time and in response to intermediate cuttings.

**Private, state, or federal cooperator.*

CABLE, DWIGHT R.
1971.
Growth and development of Arizona cottontop (*Trichachne californica* [Benth.] Chase).
Bot. Gaz. 132: 119-145.
Arizona cottontop is a productive, palatable, dominant perennial grass on many southwestern semidesert ranges. A warm-season grass, it grows mostly during summer. Perennial culms, long-lived roots, and ability to produce new shoots and flowers seasonlong make it an exceptionally valuable forage grass of the semidesert.

CABLE, DWIGHT R.
1971.
Lehmann lovegrass on the Santa Rita Experimental Range, 1937-1968.
J. Range Manage. 24: 17-21.
This grass readily establishes itself from seed, can withstand heavy grazing, and can invade established stands of velvet mesquite, but it is less palatable than native perennial grasses during the summer growing season.

CABLE, DWIGHT R.
1972.
Fourwing saltbush revegetation trials in southern Arizona.
J. Range Manage. 25: 150-153.
Establishment and survival of saltbush was much higher on a creosotebush site, where sandy loam soil was calcareous, than on a mesquite site, where neutral sandy loam surface soil was underlain with clay or clay loam.

DRISCOLL, RICHARD S.
1971.
Color aerial photography—a new view for range management.
USDA Forest Serv. Res. Pap. RM-67, 11 p.
Several shrubs can be identified more consistently on large-scale (1:600-1:1,200) color infrared aerial photographs than on the same scale color aerial photographs. Identification of relatively large forbs is also easier. Identification depends on phenology, and therefore time of year.

DRISCOLL, R. S., P. O. CURRIE, AND M. J. MORRIS.
1972.
Estimates of herbaceous standing crop by microdensitometry.
Am. Soc. Photogramm. [Washington, D. C., March 1972] Proc. 38: 358-364.
Green standing herbage of seeded big bluegrass was estimated from large-scale color infrared aerial photos. Because of heterogeneous plant species composition, however, native ranges will yield photos with more complex image density patterns.

FEDDEMA, CHARLES.
1971.
Re-establishment of the genus *Aldama* (Compositae-Heliantheae).
Phytologia 21: 308-314.
Originally described as new in 1824, *Aldama* was transferred to *Gymnopsis* in 1836, *Sclerocarpus* in 1881. Re-establishment is supported by a table of differences between *Aldama* and *Sclerocarpus*.

GALT, H. D.,* BRENT THEURER,* AND S. CLARK MARTIN.
1972.
Botanical composition of cattle diets on velvet mesquite-fair and nonmesquite-good desert grassland.
Soc. Range Manage. [Wash. D. C., Feb. 1972] Abstr. of Pap. 25: 12.
Animal diets were only slightly different between the two pastures; Arizona cottontop predominated in both. Protein content of fistula samples was consistently higher than that of the major available grasses. Excess protein was attributed to higher protein shrubs and parts of grasses.

HERMANN, FREDERICK J.
1971.
New species of *Carex* from Mexico and Guatemala.
Brittonia 23: 144-148.
Describes four new species, *Carex volcanica*, *C. guatemalensis*, *C. caxinensis*, and *C. distentiformis*, plus a new variety, *C. subbracteata* var. *tolucensis*.

HERMANN, FREDERICK J.
1972.
A new variety of *Carex bicknellii* from Arkansas.
Sida 5(1): 49.
Describes and discusses a new variety that has long been confused with *Carex brittoniana*.

*Private, state, or federal cooperator.

JAMESON, DONALD A.

1971.

Optimum stand selection for juniper control on southwestern woodland ranges.

J. Range Manage. 24: 94-99.

If the cost of the control method is fixed, older stands with zero rate of change represent optimal treatment areas, but if the cost increases with stand age, young stands represent optimal treatment situations.

KERBS, ROGER R.

1972.

Handy device for dispensing barbed wire.

J. Range Manage. 25: 72-73.

The device is held vertically in the rear stake pocket of a pickup truck. It costs about $6 to construct, reduces the possibility of wire entanglements, and frees one man of a two-man crew to do other work.

MARTIN, S. CLARK.

1971.

Burroweed invasion—cause for concern, not panic.

Ariz. Cattlelog 27(5): 15, 18-19, 22.

Dense burroweed stands are temporary in southeastern Arizona. Above-average winter-spring moisture is required for establishment and survival of large numbers of burroweed seedlings. Such stands decline sharply when cool-season moisture is well below average for two or more consecutive years.

MARTIN, S. CLARK

1972.

Semidesert ecosystems—who will use them; how will we manage them.

Soc. Range Manage. [Wash. D. C., Feb. 1972] Abstr. of Pap. 25: 16.

Maximum sustained production of forage and beef no longer is an adequate objective for management of southwestern semidesert ranges; nonrancher interests are claiming an increasing voice in their management. Recreational activities may supplement ranch income from livestock.

PARKER, H. DENNISON, JR.

1971.

A portable light table for field interpretation of aerial photographs.

USDA Forest Serv. Res. Note RM-204, 4 p.

The table accommodated two 70 mm film spools or one 9- by 9-inch transparency. The unit is powered by self-contained rechargeable batteries or from external 115 VAC or 12 VDC sources.

PARKER, H. DENNISON, JR.

1971.

Infrared 'eyes' for game management.

Colo. Outdoors 20(6): 35-38.

Airborne thermal infrared scanners can detect deer, even in dense vegetation, if they are not hidden from above. Deer can probably be detected best just before sunrise, when other objects are uniformly cold.

PARKER, H. DENNISON, JR.

1972.

Environmental factors affecting detection of wild deer with an airborne thermal infrared scanner.

Soc. Range Manage. [Wash. D. C., Feb. 1972] Abstr. of Pap. 25: 33.

Multiple regression analysis indicated air temperature was the environmental factor most closely associated with the effective radiant temperature (ERT) of deer, snow, sagebrush, rock, and bare soil. Solar radiation had a marked but highly variable effect. Thermal contrast between deer and snow was always in excess of 2C.

PEARSON, HENRY A.

1972.

Estimating cattle gains from consumption of digestible forage on ponderosa pine range.

J. Range Manage. 25: 18-20.

In vitro digestibility measurements reduce the variability in estimating cattle gains from forage intake measurements. The daily digestible forage intake requirements of range cattle appear similar to the requirements of cattle in feedlots.

PEARSON, H. A., J. F. MANN,* AND D. A. HOWARD.*

1971.

Timing use of cool- and warm-season grasses on pine ranges.

J. Range Manage. 24: 162-163.

A three-pasture rest-rotation grazing system based on plant growth and development during two annual precipitation periods resulted in more equitable utilization of Arizona fescue and mountain muhly on ponderosa pine range. Plant and cattle productivity were maintained.

POND, FLOYD W.

1971.

Chaparral: 47 years later.

USDA Forest Serv. Res. Pap. RM-69, 11 p.

Chaparral species that sprout appeared little changed after 47 years, though all stems tagged in 1920 were

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dead. Nonsprouting species had died but were usually replaced by nearby seedlings or by layering.

POND, FLOYD W., AND JOHN W. BOHNING.*

1971.

The Arizona chaparral.

Ariz. Cattlelog 27(10): 16, 18, 20, 22-28; 27(11): 13-16, 18-24.

An informal close look at the chaparral type - its composition, values, management possibilities - and the species that compose it: their characteristics, good and bad.

POND, FLOYD W., AND H. A. PEARSON.

1971.

Freeze branding cattle for individual identification.

J. Range Manage. 24: 466-467.

Freeze branding appears to be a good method of marking cattle for individual identification. In three trials, over 80 percent of the branded animals developed readable brands, but only 60 percent could be identified on Super-8 film exposed 5 feet overhead.

POND, FLOYD W., AND DIXIE R. SMITH.

1971.

Ecology and management of subalpine ranges on the Big Horn Mountains of Wyoming.

Wyo. Agr. Exp. Sta. Res. J. 53, 25 p.

Summarizes results of research since 1951 on growth and development of range plants, vegetation communities, cattle and sheep preference and diet ratings, effects of grazing intensity, grazing systems, and range improvement practices.

REICHERT, DONALD W.

1972.

Rearing and training deer for use in food habits studies.

USDA Forest Serv. Res. Note RM-208, 7 p.

Wild does are trapped in winter. Fawns are left with the doe at least 12 hours to assure feeding of colostrum, but less than 24 hours. Reliance on the human trainer develops through bottle feeding and frequent contact. Training for field use requires 4 to 6 weeks.

SPRINGFIELD, H. W.

1971.

Selection and limitations of mulching materials for stabilizing critical areas.

p. 128-161, *In* Critical Area Stabilization Workshop [Albuquerque, N. Mex. Interagency Range Comm. Rep. 74, 197 p. USDA Agr. Res. Serv., Las Cruces, N. Mex. , N. Mex., Apr. 1971] Proc. N. Mex. Interagency Range Comm. Rep. 7A, 197 p. USDA Agr. Res. Serv., Las Cruces, N. Mex.

Mulching characteristics of wood and agricultural residues, petroleum products, and plastic films are described. For summer seeding near Santa Fe, New Mexico straw and white petroleum resin were most effective; they reduced moisture losses and temperatures in the top inch of soil while seeds were germinating and seedlings emerging.

SPRINGFIELD, H. W.

1971.

Winterfat seedlings emerge best from shallow seeding, moderately dry soil.

J. Range Manage. 24: 395-397.

Emergence was best from the 1/16-inch depth, and when soil moisture was nearer field capacity than saturation.

SPRINGFIELD, H. W.

1972.

Optimum temperatures for germination of winterfat.

J. Range Manage. 25: 69-70.

Optimum temperatures for germination were 50 to 80 F. Germination was practically complete within 5 days at 59 F. or higher.

THILENIUS, JOHN F.

1971.

Vascular plants of the Black Hills of South Dakota and adjacent Wyoming.

USDA Forest Serv. Res. Pap. RM-71, 43 p.

This checklist gives the scientific name and botanical authority, the plant family (and tribe for Gramineae and Compositae), an alphabetical symbol adapted for computer coding, and a life-form designation for 1,759 plant taxa of the Black Hills of South Dakota and Wyoming. The environment and vegetation types of the Black Hills are discussed.

TURNER, GEORGE T.

1971.

Soil and grazing influences on a salt-desert shrub range in western Colorado.

J. Range Manage. 24: 31-37.

Although distinct soil-vegetation relationships were evident, changes attributable to grazing were relatively small. Vegetation and other cover on nongrazed range was practically the same at the end as at the beginning of the study. Inherently low site capability and subnormal precipitation were believed responsible for the lack of response to livestock exclusion.

*Private, state, or federal cooperator.

WOODMANSEE, ROBERT G.,* AND LOREN D. POTTER.*

1971.

Natural reproduction of winterfat (*Eurotia lanata*) in New Mexico.

J. Range Manage. 24: 24-30.

A comparison of vegetation on heavily grazed and protected ranges indicated winterfat was susceptible to heavy grazing, and reproduced when on protected or lightly grazed range dominated by low-growing grasses.

shelterbelt management

COOK, DAVID I.,* AND DAVID F. VAN HAVERBEKE.

1971.

Audio pollution and means for its control.

Exploring Nebr. Pollution Problem [Lincoln, Nebr., Apr. 1971] Proc. p. E-1-E-9. Nebr. Ext. Serv., Lincoln.

Properly designed plantings of trees and shrubs significantly reduce noise. Wide, dense belts are most effective for rural applications, and narrower belts of dense shrubs backed by tall trees are effective in urban areas. When trees and shrubs are combined with soft surfaces, apparent loudness may be reduced 50 percent under optimum conditions.

COOK, DAVID I.,* AND DAVID F. VAN HAVERBEKE.

1971.

The role of trees and shrubs in noise abatement.

Role of Trees in South's Urban Environment Symp. [Athens, Ga., Jan.-Feb. 1971] Proc. 1971: 12-19.

Properly designed plantings of trees and shrubs may reduce apparent loudness 50 percent. Wide, dense belts are most effective in rural areas; narrower belts of dense shrubs backed by taller trees are effective against tire-roadway noise in urban areas. Reduction is most pronounced when trees and shrubs are combined with soft approach surfaces.

COOK, DAVID I.,* AND DAVID F. VAN HAVERBEKE.

1971.

Trees and shrubs for noise abatement.

Nebr. Agr. Exp. Sta. Res. Bull. 246, 77 p.

Sound levels may be reduced (attenuated) by 10 decibels (about half as loud) by wide belts of tall, dense trees. A soft approach surface further reduces noise. Discussion of tree belts and anticipated noise attenuation calculations are highly technical.

COOK, DAVID I.,* AND DAVID F. VAN HAVERBEKE.

1971.

Trees and shrubs for noise abatement.

Trees and Forests in an Urbanizing Environment Symp. [Amherst, Mass., Aug. 1970] Proc. 1971: 39-41.

Properly designed plantings of trees and shrubs may reduce apparent loudness 50 percent. Wide, dense belts are most effective in rural areas; narrower belts of dense shrubs backed by taller trees are effective against tire-roadway noise in urban areas. Reduction is most pronounced when trees and shrubs are combined with soft approach surfaces.

CUNNINGHAM, RICHARD A.

1972.

Development of Siberian and Dahurian larches after 10 years in North Dakota.

USDA Forest Serv. Res. Note RM-209, 4 p.

Trees were grown from three Siberian larch, one Dahurian larch, and two hybrid larch seed sources. Two Siberian origins may be suitable for windbreak plantings in the Northern Great Plains.

READ, RALPH A.

1971.

Browsing preference by jackrabbits in a ponderosa pine provenance plantation.

USDA Forest Serv. Res. Note RM-186, 4 p.

Black-tailed jackrabbits, in a young ponderosa pine plantation of 79 provenances in central Nebraska, browsed the western sources more heavily than sources from east of the Continental Divide.

READ, RALPH A.

1971.

Scots pine in eastern Nebraska: a provenance study.

USDA Forest Serv. Res. Pap. RM-78, 13 p.

Results after 8 years reveal that (1) southern origins bordering the Mediterranean grow slowly to moderately fast and remain dark green in winter, (2) central European origins grow very fast and turn yellowish green in winter, (3) northern origins grow slowly and turn very yellow in winter.

*Private, state, or federal cooperator.

READ, RALPH A.

1972.

Plan before planting tree windbreaks.

Colo. Rancher and Farmer 26(2): 30,34.

In addition to physical design and selection of species, planning must include purposes of the windbreak, maintenance, and correlation with other conservation practices.

SANDER, D. H.

1971.

Soil properties and Siberian elm tree growth in Nebraska windbreaks.

Soil Sci. 112: 357-363.

Nitrogen and zinc fertilization on some soils in the Loess Plains region could promote Siberian elm height growth. Maximum response over a 20-year period could be 10 to 15 feet.

TINUS, RICHARD W.

1971.

Growth of ponderosa pine, white spruce, and blue spruce under clear and red fluorescent plastic.

USDA Forest Serv. Res. Note RM-184, 4 p.

Pinus ponderosa, *Picea glauca*, and *Picea pungens* tended to be larger and heavier when grown under a covering of red fluorescent plastic rather than under clear polyethylene, although in most cases the differences were not statistically significant. The effects of reduced temperature and altered spectrum were not separated.

TINUS, RICHARD W.

1971.

Response of ponderosa pine and blue spruce to day and night temperature.

Plant Physiol. 47(suppl.): 30, Abstr. 176.

Paper presented at annual meeting of American Society of Plant Physiologists, Pacific Grove, California, August 22-26, 1971. Optimum day temperature varied with growth parameter: height 25 C, caliper 23 C, dry weight 20 C. Optimum night temperature was 25 C.

TINUS, RICHARD W.

1972.

Carbon dioxide enriched atmosphere speeds growth of ponderosa pine and blue spruce seedlings.

Tree Planters' Notes 23(1): 12-15.

Height, caliper, and number of side branches of 1-year-old seedlings grown under 1200 ppm carbon dioxide were greater than for seedlings grown under ambient air. Fresh and dry weights were strikingly greater.

VAN HAVERBEKE, DAVID F., ROBERT E. ROSELLE,* AND GARY D. SEXSON.*

1971.

Western pine tip moth reduced in ponderosa pine shelterbelts by systemic insecticides.

USDA Forest Serv. Res. Note RM-194, 8 p.

A late-winter or early-spring application of 40 grams of phorate granules (Thimet 15G) raked into the soil beneath each tree crown should inexpensively and effectively protect young ponderosa pine in Great Plains shelterbelts and windbreaks from damage by western pine tip moth for two growing seasons.

WRIGHT, J. W.,* F. H. KUNG,* R. A. READ, W. A. LEMMIEN,* AND J. N. BRIGHT.*

1971.

Genetic variation in Rocky Mountain Douglas-fir.

Silvae Genet. 20: 54-60.

Seeds from 128 stands were grown in Michigan; seedlings were transplanted in Michigan and Nebraska. Arizona - New Mexico seed sources produced the most consistent blue color, and were tallest in Michigan, but suffered heavy winter damage. They were most suitable for eastern Nebraska, however.

WRIGHT, J. W.,* F. H. KUNG,* R. A. READ, R. J. STEINHOFF,* AND J. W. ANDRESEN.*

1971.

Nine-year performance of *Pinus flexilis* and *P. strobiformis* progenies in Michigan and Nebraska.

Silvae Genet. 20: 211-214.

Trees from seeds collected in 51 natural stands were grown in Michigan and Nebraska plantations. *P. strobiformis* from Arizona and New Mexico grew uniformly rapidly and had dark blue-green foliage. *P. flexilis* grew less than half as fast.

*Private, state, or federal cooperator.

silviculture

ALEXANDER, ROBERT R.

1971.

Crown competition factor (CCF) for Engelmann spruce in the central Rocky Mountains.

USDA Forest Serv. Res. Note RM-188, 4 p.

The relationship between maximum crown area and stem diameter at breast height is the basis for computing the Crown Competition Factor (CCF), a measure of stand density.

ALEXANDER, ROBERT R.

1971.

Initial partial cutting in old-growth spruce-fir.

USDA Forest Serv. Res. Pap. RM-76, 8 p.

Interim guidelines are provided to aid the forest manager in developing alternatives to clearcutting in old-growth spruce-fir forests in Colorado and southern Wyoming. Included are practices for different conditions that should maintain continuous high forest cover to preserve the forest landscape, and that may also be used with small cleared openings to integrate timber production with other key uses. For convenient field use, a smaller, brief version entitled 'Initial partial cutting in old-growth spruce fir: a field guide' is available as USDA Forest Serv. Res. Pap. RM-76A.

ALEXANDER, ROBERT R., AND DANIEL L. NOBLE.

1971.

Effects of watering treatments on germination, survival, and growth of Engelmann spruce: a greenhouse study.

USDA Forest Serv. Res. Note RM-182, 6 p.

There was no significant survival after 24 weeks until 1.0 or more inches of water was received monthly, applied at intervals throughout the month, whereas few seedlings survived until 2.0 inches of water was received monthly in a single watering.

BOLDT, CHARLES E.

1971.

Stocking and growth in even-aged forest stands: a simple, instructional model.

S. Dak. Acad. Sci. Proc. 50: 79-84.

Through graphic modeling, explains the interaction of the three variables that affect the stocking—growth relationship most; site productivity or quality; spatial distribution of stand elements; inherent growth efficiency or ability to compete.

EMBRY, ROBERT S.

1971.

Soil water availability in an Arizona mixed conifer clearcutting.

USDA Forest Serv. Res. Note RM-206, 4 p.

Under burned and scalped surfaces, adequate moisture was available for survival of established seedlings and planted stock throughout the growing season on all exposures. Only under grass did soil moisture deficits approach or exceed the permanent wilting point.

EMBRY, ROBERT S., AND GERALD J. GOTTFRIED.

1971.

Basal area growth of Arizona mixed conifer species.

USDA Forest Serv. Res. Note RM-198, 3 p.

Annual gross basal area increment was estimated to be 4 square feet per acre, a 2.3 percent annual increase.

EMBRY, ROBERT S., AND GERALD J. GOTTFRIED.

1971.

Frequency of stem features affecting quality in Arizona mixed conifer species.

USDA Forest Serv. Res. Pap. RM-70, 19 p.

Data were obtained in an overstory inventory on 1,800 acres of mixed conifer forests in the Arizona White Mountains. Frequency-of-occurrence of visual stem-quality features affecting end product quality and yield are presented by species and size-class.

EMBRY, R. S., AND G. J. GOTTFRIED.

1971.

Height-diameter equations for Arizona mixed conifers.

USDA Forest Serv. Res. Note RM-191, 2 p.

Relationships between total height and diameter breast high in Arizona virgin mixed conifer stands may be expressed by the equation $\log (H - 4.5) = b(\log D) + c(\log D)(\log D)$.

JONES, JOHN R.

1971.

An experiment in modeling Rocky Mountain forest ecosystems.

USDA Forest Serv. Res. Pap. RM-75, 19 p.

This prototype model consists of a temperature regime ordinate, a moisture regime ordinate, and a regression equation relating them to aspen site index in the southern Rocky Mountains. Clonal variation in aspen height growth prevented a good test of the model, however.

JONES, JOHN R.

1971.

Mixed conifer seedling growth in eastern Arizona.

USDA Forest Serv. Res. Pap. RM-77, 19 p.

In a small opening receiving no direct sunlight, height growth was very slow. In an abandoned roadway receiving direct sunlight briefly at midday, growth was moderately faster. Seedlings grew much faster in a clearcutting. Species responded differently to release by partial cutting.

RONCO, FRANK, AND DANIEL L. NOBLE.

1971.

Engelmann spruce regeneration in clearcut openings not insured by record seed crop.

J. Forest. 69: 578-579.

In 1967, up to 5.3 million seeds per acre were caught under uncut stands. Dispersal into clearcuts decreased rapidly to a minimum about 4 to 5 chains from the windward uncut stand. Seedfall was abundant on 4 areas, but 1-year-old seedlings in 1968 were numerous on only 2.

SCHUBERT, GILBERT H.

1971.

Growth response of even-aged ponderosa pines related to stand density levels.

J. For. 69: 857-860.

Dense stands of slow-growing trees were thinned to six residual growing stock levels. The 100 largest trees per acre increased in diameter, basal area, and volume with increasing growing space. After heaviest thinning, net annual d.b.h. growth was 4.6 times greater than prethinning rate.

SCHUBERT, GILBERT H.

1971.

The phenology of bristlecone pine on the San Francisco Peaks of Arizona.

J. Ariz. Acad. Sci. 6: 245-248.

Bristlecone pines initiate flower and vegetative buds during late July and early August. Flower bud initiation to mature seed covers about 26 months. Another 9 months are required before the seed develops into a young plant. Contents similar to USDA Forest Serv. Res. Note RM-180.

SCHUBERT, GILBERT H., AND RONALD S. ADAMS.*

1971.

Reforestation practices for conifers in California.

359 p. Calif. Div. For., Sacramento.

Summarized technical information from many sources, some hitherto unpublished, in five chapters: cone and seed handling practices, nursery practices that affect the production of planting stock, site preparation for both planting and direct seeding, planting, and direct seeding.

VAN DEUSEN, JAMES L.

1971.

Radio-tagged pine seeds easily relocated in Black Hills trials.

S. Dak. Acad. Sci. Proc. 50: 238-243.

Sc 46 was used successfully as a research tool in tagging ponderosa pine seeds. Seed movement could be traced by periodic relocation with a scintillator, and seeds that did not germinate were easily recovered.

watershed management

ALDON, EARL F., AND H. GASSAWAY BROWN III.*

1971.

Geologic soil groupings for the pinyon-juniper type on National Forests in New Mexico.

USDA Forest Serv. Res. Note RM-197, 4 p.

Almost 29 percent of the pinyon-juniper type is on highly unstable geologic formations that contribute to high sediment yields. Sedimentary units make up 54 percent of the acreage in the type, igneous units 39 percent, and Pre-Cambrian formations 7 percent.

ALDON, EARL F., AND GEORGE GARCIA.

1971.

Stocking rangelands on the Rio Puerco in New Mexico.

J. Range Manage. 24: 344-345.

Using formulas developed on an experimental range unit in the Rio Puerco drainage, stocking rates in animal units per section are given based on perennial grass forage production and utilization percentages.

BERGEN, J. D.

1971.

An inexpensive heated thermistor anemometer.

Agr. Meteorol. 8: 395-405.

The windspeed-output calibrations of 16 instruments indicate acceptable sensitivity below speeds of 4 m per second. The anemometer is inexpensive and seems well adapted to measurement of air movement in vegetation.

Private, state, or federal cooperator.

BERGEN, J. D.

1971.

Topographic effects apparent in nocturnal temperature profiles in a conifer canopy.

Agr. Meteorol. 9: 39-50.

The behavior of a maximum in a temperature profile well within the canopy indicates it is due to subsidence heating caused by topographically induced divergence of the density flow in the canopy.

BERGEN, JAMES D.

1971.

The relation of snow transparency to density and air permeability in a natural snow cover.

J. Geophys. Res. 76: 7385-7388.

The correlation between the transparency of snow (measured in undisturbed snow with CdS cells) and its air permeability and density was in fair agreement with the model of Dunkle and Bevans and the Carmen-Kozney relation.

BERGEN, JAMES D.

1971.

Vertical profiles of windspeed in a pine stand.

Forest Sci. 17: 314-321.

The average profile showed a minimum near the displacement level (2/3 tree height), with speeds of about twice the friction velocity, and a subcanopy maximum of four times the friction velocity.

CAMPBELL, RALPH E.

1971.

Evaporation from bare soil as affected by texture and temperature.

USDA Forest Serv. Res. Note RM-190, 7 p.

Evaporation of water under several drying conditions was studied in six soils from the Rio Puerco drainage of New Mexico. Sandy soils lost half their moisture in 5 and 7 days at 90 F and 60 F, respectively, compared to 8 and 15 days for clay soils. After rapid initial loss, the dried surface of sandy soils acted as a barrier to further moisture loss.

GARY, HOWARD L.

1971.

Seasonal and diurnal changes in moisture contents and water deficits of Engelmann spruce needles.

Bot. Gaz. 132: 327-332.

Moisture percentages reached a seasonal high in March and a low before budbreak in June. The decline was primarily due to an increase in dry matter. Water deficits were highest during the primary growing season, June through October.

GARY, HOWARD L.

1972.

Rime contributes to water balance in high-elevation aspen forests.

J. For. 70:93-97.

The water contribution from rime for each of two winters studied was about 1 inch.

HAEFFNER, ARDEN D.

1971.

Daily temperatures and precipitation for subalpine forest, central Colorado.

USDA Forest Serv. Res. Pap. RM-80, 48 p.

Records collected over a 33-year period at 9,070 feet showed a mean annual temperature of 33 F., with extremes ranging from -42 to 91 F. Annual precipitation ranged from 17 to 28 inches, with an average of 23. Maximum temperatures were lower and minimums higher at 10,620 feet.

HEEDE, BURCHARD H.

1971.

Characteristics and processes of soil piping in gullies.

Amer. Geophys. Union Trans. 52: 204. (Abstr.)

Paper presented at American Geophysical Union meeting, Washington, D. C., April 12-16, 1971. Prerequisites to the formation of soil pipes appear to be gullies, high exchangeable sodium percentage, low gypsum content, and fine-textured soils with montmorillonite clay.

HEEDE, BURCHARD H.

1971.

Characteristics and processes of soil piping in gullies.

USDA Forest Serv. Res. Pap. RM-68, 15 p.

Gullies, high exchangeable sodium percentage, low gypsum content, and fine-textured soils with montmorillonite clay appeared to be prerequisite to the formation of pipes. Soil piping led to natural reclamation of the soils, and in turn to stabilization of gully side slopes.

HIBBERT, ALDEN R.

1971.

Increases in streamflow after converting chaparral to grass.

Water Resour. Res. 7: 71-80.

When annual precipitation is less than 16 inches, increase in water yield from treatment is likely to be less than 2 inches. However, the efficiency of the conver-

sion for producing extra water improves with rainfall, at least up to 34 inches, where the increase in flow may reach 12 inches or more.

HIBBERT, ALDEN R., AND WILSON B. CASNER.

1971.

Reducing excess readouts from digital streamflow recorders.

Water Resour. Res. 7: 415-418.

A two-step reduction process eliminates more than 95 percent of the original 5-minute-interval data points per year of record. The first translates to IBM cards only every twelfth head value punched during nonstorm periods. A computer reduction step then systematically rejects head values not essential to hydrograph definition.

HIBBERT, ALDEN R., AND PAUL A. INGEBO.

1971.

Chaparral treatment effects on streamflow.

p. 25-34. *In* 15th Ann. Ariz. Watershed Symp. [Phoenix, Ariz., Sept. 1971] Proc. Ariz. Water Comm. Rep. 1, 55 p. Phoenix, Ariz.

Yield increases averaged from more than 6 inches per year (fivefold increase) on wet sites under dense brush to less than 1 inch on dry sites under open stands. Yield increases can probably be retained without eliminating downstream riparian vegetation.

HOOVER, MARVIN D.

1971.

Water yield management for forest lands.

Four States Irrig. Coun. [Denver, Colo., Jan 1971] Proc. 20: 98, 108-109.

Forests make maximum contribution to water yield near timberline, where the growing season is short, but forest influence on wind, and therefore snow deposition, is great. Forest with 1/3 its area in protected openings less than 10 tree heights wide appears to trap snow most effectively.

INGEBO, PAUL A.

1971.

Suppression of channel-side chaparral cover increases streamflow.

J. Soil and Water Conserv. 26: 79-81.

Shrubs and trees along channels in a 246-acre watershed in central Arizona were chemically suppressed. Streamflow, normally intermittent during summer and fall, became continuous. Flow increased 0.63 and 0.97 area-inch (32 and 54 percent) in the years, or in terms of the treated area only (15 percent of the watershed), 4.1 and 6.3 inches.

INGEBO, PAUL A., WILSON B. CASNER, AND GARY L. GODSEY.

1971.

A computer program for computing streamflow volumes.

USDA Forest Serv. Res. Note RM-203, 8 p.

Computations are based on tabulations of gage heights prepared from continuous stream-gage records. Any of several formulas or rating tables may be selected for each water year's computations. Elements of flow show in a sequence printout of daily volumes.

JUDSON, ARTHUR.

1971.

An infrared de-icing unit for cup anemometers.

USDA Forest Serv. Res. Note RM-187, 4 p.

Electric infrared lamps yielding 0.5 watt radiant energy per square centimeter of cup surface prevented icing on an exposed mountain anemometer in Colorado. The unit performed well during all rime conditions for two consecutive winters. Parts for the inexpensive unit are commercially available.

KNIPE, O. D.

1971.

Effect of different osmotica on germination of alkali sacaton (*Sporobolus airoides* Torr.) at various moisture stresses.

Bot. Gaz. 132: 109-112.

Only Carbowax 4000 reduced seed germination at 3.0 atm. over 0.3 atm. Germination of seeds treated with Carbowax 200 was less at 8.0, 12.0, and 15.0 atm. than with mannitol and Carbowax 4000, but there were no differences in germination with the latter two osmotica.

KNIPE, O. D.

1971.

Imbibition by alkali sacaton seeds.

J. Range Manage. 24: 71-73.

Large seeds gained 47 percent and small seeds 71 percent of their dry weight within the first 30 minutes after wetting. Large seeds gained 124 percent and small seeds 165 percent of their dry weight after 72 hours.

KNIPE, O. D.

1971.

Light delays germination of alkali sacaton.

J. Range Manage. 24: 152-154.

Exposure of seeds to light for a few seconds after imbibition delayed germination 24 hours, exposure for 9 to 13 hours delayed germination 28 hours, more than

13 hours delayed germination 72 hours, and continuous exposure reduced germination 40 percent.

LEAF, CHARLES F.

1971.

Areal snow cover and disposition of snowmelt runoff in central Colorado.

USDA Forest Serv. Res. Pap. RM-66, 19 p.

High water yield efficiencies were observed on two watersheds which had: (1) almost complete snow cover when seasonal snowmelt rates on all major aspects were maximum; (2) a delayed and short snow-cover depletion season; and (3) moderate recharge and evapotranspiration losses.

LEAF, CHARLES F., AND ARDEN D. HAEFFNER.

1971.

A model for updating streamflow forecasts based on areal snow cover and a precipitation index.

West. Snow Conf. [Billings, Mont., Apr. 1971] Proc. 39: 9-16.

The model has enough flexibility to account for unusual hydrologic conditions. With additional records, the method should provide accurate residual flow forecasts during the critical high-flow period on the small Fraser watersheds.

LEAF, CHARLES F., AND JACOB L. KOVNER.

1971.

Guidelines for sampling area-mean water equivalent in forested watersheds.

p. 159-167. *In* Hydrometeorological networks in Wyoming—their design and use. Hydrol. Seminar [Laramie, Wyo., May 1971] Proc., 167 p. Water Resour. Res. Inst. Rep., Wyo. Univ., Laramie.

The most efficient snow course sampling scheme for measuring winter snow accumulation on uniformly forested small watersheds in central Colorado involves sampling: (1) zones that are stratified according to elevation with proportional sampling in each; (2) points widely spaced over each zone, with at most two duplicate measurements at a location.

LUSBY, GREGG C.,* VINCENT H. REID,* AND O. D. KNIPE.

1971.

Effects of grazing on the hydrology and biology of the Badger Wash basin in western Colorado, 1953-66. Hydrologic effects of land use.

U. S. Geol. Surv. Water-Supply Pap. 1532-D. 90 p.

Runoff from ungrazed watersheds averaged from 71 to 76 percent of that from grazed watersheds. Changes in ground cover were not large, however. Much of the difference in runoff may be due to a change in structure of the surface soil brought about by elimination of trampling by livestock.

MARTINELLI, M., JR.

1971.

Physical properties of alpine snow as related to weather and avalanche conditions.

USDA Forest Serv. Res. Pap. RM-64, 35 p.

Density, strength, ram resistance, air permeability, and snow grain size and type are given for dry alpine snow, mostly less than 2 weeks old. Data were taken in the starting zone of a small avalanche near Berthoud Pass, Colorado.

MARTINELLI, M., JR.

1972.

Take the plunge.

Ski Area Manage. 11(1): 26-28.

The rammsonde is a simple, reliable device for measuring snow compaction or hardness. It can help the ski area manager evaluate trail maintenance techniques and results.

ORR, HOWARD K.

1972.

Throughfall and stemflow relationships in second-growth ponderosa pine in the Black Hills.

USDA Forest Serv. Res. Note RM-210, 7 p.

Rainfall alone accounted for 85 to 99 percent of throughfall variation. Stemflow was also primarily dependent on rainfall. Results further demonstrate adjustment of throughfall for mean canopy density, adjustment of stemflow for tree d.b.h., and combination of these relationships to estimate net rainfall for different stand densities.

PASE, CHARLES P.

1971.

Effect of a February burn on Lehmann lovegrass.

J. Range Manage. 24: 454-456.

Density and vigor of Lehmann lovegrass were essentially unaffected by burning which resulted in a 90 percent topkill of shrub live oak sprouts. Some increases were noted in King Ranch and yellow bluestem and associated native forbs.

PASE, CHARLES P., AND A. W. LINDENMUTH, JR.

1971.

Effects of prescribed fire on vegetation and sediment in oak-mountain mahogany chaparral.

J. Forest. 69: 800-805.

**Private, state, or federal cooperator.*

Results show good but very temporary control of oakmountain mahogany chaparral with carefully prescribed fire. The technique appears less damaging to the site than wildfires or those broadcast fires with less carefully controlled prescription and execution.

PERLA, R. I.

1971.

Generalization of Haefeli's creep angle analysis.

Am. Geophys. Union Trans. 52: 825.(Abstr.)

A generalization of the creep angle, called the deformation-rate coefficient, is derived by replacing geometrical arguments with continuum mechanics. Once the coefficient is found from *in situ measurements, the stress field of the slab can be determined from a set of hyperbolic partial differential equations.*

RICH, LOWELL R.

1971.

Hydrologic changes and their influence on the environment in a ponderosa pine forest.

Amer. Geophys. Union Trans. 52: 201. (Abstr.)

Paper presented at the American Geophysical Union meeting, Washington, D. C., April 12-16, 1971. Removal of one-sixth of the timber stand on an Arizona watershed increased water yields with low sediment yields.

SCHMIDT, R. A.

1971.

Processing size, frequency, and speed data from snow particle counters.

USDA Forest Serv. Res. Note RM-196, 4 p.

Describes techniques for electronically processing magnetic tape records from a photoelectric snow particle counter. Examples of the resulting particle size distributions, particle frequency plots, and measurements of particle speed are included.

SCHMIDT, R. A., JR.

1971.

How to get the snow where you want it to go.

Skiing Area News 6(3): 20-21, 43-44.

Through examples, shows how general principles of snow fence design and specific data may be applied to certain wind-caused snow control problems on ski areas.

SCHMIDT, R. A., JR., AND E. W. HOLUB.

1971.

Calibrating the snow particle counter for particle size and speed.

USDA Forest Serv. Res. Note RM-189, 8 p.

Laboratory calibration of a photoelectric snow particle counter shows the device gives useful estimates of particle speed and size without large temperature corrections, although some field adjustments are necessary for optimum performance.

SCHOLL, DAVID G.

1971.

Soil wettability in Utah juniper stands.

Soil Sci. Soc. Amer. Proc. 35: 344-345.

Resistance to wetting increased from completely wettable in open areas to highly nonwettable in the litter under the juniper canopy. Resistance decreased with depth below the litter. Organic matter increased resistance to wetting. Wettability, determined at 1/3 and 15 bars moisture tension and air-dry, was least at 15 bars.

SMITH, F. W.,* AND R. A. SOMMERFELD.

1971.

Elastic stresses in layered snow packs.

Amer. Geophys. Union Trans. 52: 825. (Abstr.)

A constant strain 2-dimensional finite element computer program was used to compute elastic stress distributions in realistic multilayered snow packs simulating conditions on the Lift Gully, Berthoud Pass, Colorado. Stress levels obtained were reasonable compared to available snow strength data.

SMITH, F. W.,* R. A. SOMMERFELD, AND R. O. BAILEY.*

1971.

Finite-element stress analysis of avalanche snowpacks.

J. Glaciol. 10: 401-405.

Fairly simple mechanical characterizations of snow may give results of practical accuracy. Both field experience and calculated shear stresses predict avalanching in lower-density snows. Tensile stresses were present only in the area of the observed fracture line.

SOMMERFELD, R. A.

1971.

The bulk tensile strength of snow.

Amer. Geophys. Union Trans. 52: 825. (Abstr.)

Calculations were based on a 2-parameter flaw model for the brittle failure of snow. Parameters were a, flaw tip radius, and c, flaw half-length. If a = 0.3 mm, the largest model flaw size corresponding to the weakest measured value has c = 50 mm.

*Private, state, or federal cooperator.

SOMMERFELD, R. A.

1971.

The relationship between density and tensile strength in snow.

J. Glaciol. 10: 357-362.

'Weakest link' theories predict that the brittle fracture of snow is inherently a statistical problem. Probability of failure of snow in centrifugal tensile tests is shown to be a function of applied stress divided by a characteristic maximum strength that is a function of density alone.

TABLER, RONALD D.

1971.

Design of a watershed snow fence system, and first-year snow accumulation.

West. Snow Conf. [Billings, Mont., Apr. 1971] Proc. 39: 50-55.

Illustrates factors to be considered in the design of efficient snow fences. Estimates of amount of relocated snow available at the fence agreed reasonably well with that caught behind the fence the first winter.

TABLER, RONALD D., AND DONALD L. VEAL.*

1971.

Effect of snow fence height on wind speed.

Int. Assoc. Sci. Hydrol. Bull. 16(4): 49-56.

Efficiency of snow collection depends on the reduction in wind speed in the lee of the fence. Expressions are given for the velocity reduction factor at distances down-wind of fences having a bottom gap, and for the cross-sectional area of a fully developed drift.

TABLER, RONALD D., AND KENDALL L. JOHNSON.

1971.

Snow fences for watershed management.

Snow and Ice in Relation to Wildlife and Recreation Symp. [Ames, Iowa, Feb. 1971] Proc. 1971: 116-121.

Snow fences on the windswept High Plains show promise for diversion of water, reducing sublimation of windblown snow, and subsequent management of the snowpack. First-year results show a snow fence increased peak snowpack by 70 to 100 percent.

TABLER, RONALD D., AND ROBERT L. JAIRELL.

1971.

A recording gage for blowing snow.

USDA Forest Serv. Res. Note RM-193, 7 p.

A rotating recording gage to sample the horizontal mass flux of blowing snow was devised by attaching a snow trap to a recording precipitation gage mounted on a turntable. Two years of experience has shown the record to be useful for determining windspeed thresholds of blowing snow, for comparing relative amounts of drifting snow at different locations, and for determining the source of blowing snow at snow fence sites.

WYOMING HIGHWAY DEPARTMENT.

1971.

A blizzard wizard's role in snow control.

The Highwayman 21(4): 2-5.

1972.

Fencing parries winter's thrusts.

The Highwayman 22(1): 12-14.

These two feature stories by the Wyoming Highway Department describe snow control research being done by Drs. R. D. Tabler and R. A. Schmidt, Jr., of the Rocky Mountain Station in cooperation with that Department.

wildlife habitat

BOEKER, ERWIN L.,* VIRGIL E. SCOTT,* HUDSON G. REYNOLDS, BYRON A. DONALDSON.*

1972.

Seasonal food habits of mule deer in southwestern New Mexico.

J. Wildl. Manage. 36: 56-63.

Deer apparently subsist satisfactorily on a diet dominated by browse species, of which birchleaf mountain-mahogany and oaks are most important. Forbs are an important supplement, especially during years with favorable spring and summer rain.

EVANS, KEITH E.

1972.

Energetics of sharp-tailed grouse during winter.

Soc. Range Manage. [Wash. D. C., Feb. 1972] Abstr. of Pap. 25: 24.

Winter energetics were analyzed within a mathematical framework for predicting energy requirements, feed intake, and weight changes at varying temperatures and wind velocities, thus establishing a base for management decisions involving food and cover for sharp-tails on northern Great Plains ranges.

*Private, state, or federal cooperator.

EVANS, KEITH E., AND JAMES C. CRUSE.*

1971.

Over the badlands wall.

S. Dak. Conserv. Dig. 37(3): 20-23.

A brief look at the location, history, and wildlife of the three National Grasslands of South Dakota, and research and management plans to improve them.

GARTNER, F. ROBERT,* AND KIETH E. SEVERSON.

1971.

Fee hunting in western South Dakota.

Amer. Soc. Range Manage. [Reno, Nev., Feb. 1971] Abstr. of Pap. 24: 29-30.

Describes the unique biological and social problems in the development and growth of an economically successful hunting corporation, formed by ranchers, designed to harvest trophy deer.

KUNDAELI, JOHN N.,* AND HUDSON G. REYNOLDS.

1972.

Desert cottontail use of natural and modified pinyon-juniper woodland.

J. Range Manage. 25: 116-118.

Pinyon-juniper woodland is often cleared to improve grazing for livestock. In southern New Mexico, cottontail habitat can be maintained during clearing operations by preserving some combination of 70-90 down, dead trees and living shrubs per acre.

MESSNER, H. E.

1971.

Potting soil dispenser works well.

Tree Planters' Notes 22(4): 14.

With a simple, inexpensive, overhead-supported system, one person can fill 600 potting cups with soil mixture per hour.

REYNOLDS, HUDSON G.

1971.

Animals and environment.

Alfa Laval Int. 1970/71: 65-67.

Animals are an extremely important part of the total environment of man. Control of animal numbers is the key to balancing harvest and production of the forage supply. Proper variety and interspersion of habitat conditions are the essence of producing wildlife.

REYNOLDS, HUDSON G.

1971.

Game production and harvest in Czechoslovakia.

J. Forest. 69: 736-740.

The basic objective is maintenance of quality game populations in harmony with forestry and agriculture. Game management is intensive, as reflected by plans for breeding, winter feeding of hooved game, carefully detailed harvest, and strict hunter qualification.

REYNOLDS, HUDSON G.

1971.

The Austrians call it *landwirtschaftlichebetreid*.

Amer. Forests 77(9): 14-17, 51.

Forest lands are more intensively managed in Austria than in America, but multiple use is still a workable solution to competing demands for a common land base.

URNESS, PHILIP J., WIN GREEN, AND ROSS K. WATKINS.

1971.

Nutrient intake of deer in Arizona chaparral and desert habitats.

J. Wildl. Manage. 35: 469-475.

Despite differences in habitat and diet composition, white-tailed and mule deer have similar intakes of protein, phosphorus, calcium, and fiber. Digestibility is somewhat more variable. Phosphorus appears inadequate in early winter, although selection for higher-quality plants and plant parts may compensate.

WARD, A. LORIN.

1971.

In vitro digestibility of elk winter forage in southern Wyoming.

J. Wildl. Manage. 35: 681-688.

Digestible dry matter in 11 forage species was determined using rumen inoculum from cattle and elk. Four grasses averaged 43.3 percent DDM. There were significant changes in digestion coefficients through the winter. Source of inoculum affected digestion.

WALLMO, OLOF C., AND R. BRUCE GILL.*

1971.

Snow, winter distribution, and population dynamics of mule deer in the central Rocky Mountains.

Snow and Ice in Relation to Wildlife and Recreation Symp. [Ames, Iowa, Feb. 1971] Proc. 1971: 1-15.

Fourteen years of data show heavy snow winters were followed by population declines, and light snow winters by population increases. Mortality was high in heavy snow winters, followed by low productivity; mortality was low in light snow winters, followed by high productivity.

*Private, state, or federal cooperator.

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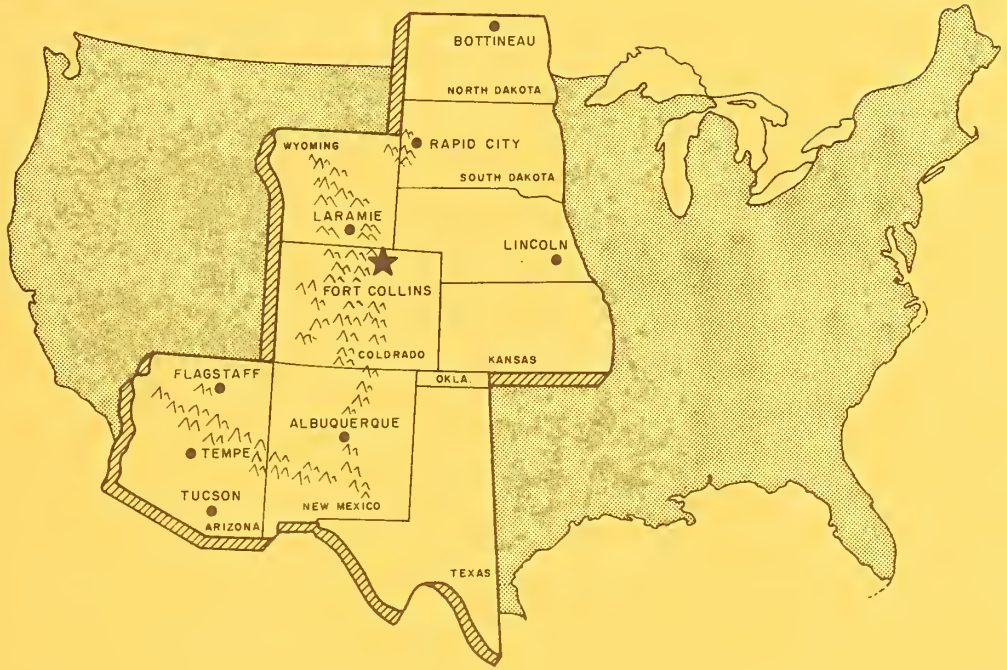

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